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NATIONAL DAM SAFETY PROGRAM. J. M. KIRCHER DAM (MO 31075), OSAGE--ETC(U)
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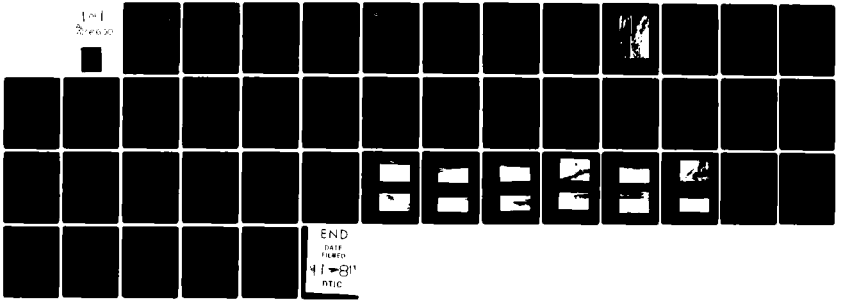

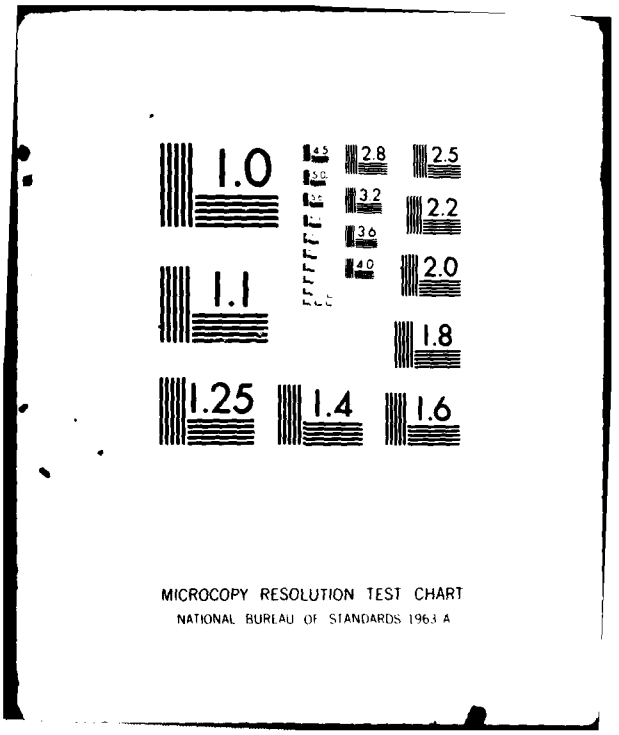
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LEVEL II

OSAGE-GASCONADE BASIN

AD A106600

J.M. KIRCHER DAM

CASS COUNTY, MISSOURI

MO 31075

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE 1979

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Kircher, J.M. Dam (MO 31075) Cass County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report
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7. AUTHOR(s) Black & Veatch, Consulting Engineers	8. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-0040
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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OSAGE-GASCONADE BASIN

J.M. KIRCHER DAM

CASS COUNTY, MISSOURI

MO 31075

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE 1979

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: J.M. Kircher Dam Mo. ID No. 31075
Phase I Inspection Report

This report presents the results of field inspection and evaluation of the J.M. Kircher Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED — Chief, Engineering Division — 14 JAN 1980 — Date

APPROVED BY: SIGNED — Colonel, CE, District Engineer — 14 JAN 1980 — Date

J. M. KIRCHER DAM

CASS COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31075

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

JUNE 1979

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	J. M. Kircher Dam
State Located	Missouri
County Located	Cass County
Stream	Tributary to Camp Branch
Date of Inspection	7 June 1979

J. M. Kircher Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten the life and property of approximately six families and two buildings downstream of the dam and would potentially cause appreciable damage to the bridges of two railroads and one unimproved road within the estimated damage zone which extends approximately two miles downstream of the dam. The failure of this dam may cause the P. D. Kircher Dam downstream to fail, which then would cause the damage mentioned above.

Our inspection and evaluation indicates the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway design flood recommended by the guidelines is 50 to 100 percent of the probable maximum flood. The spillway will not pass either the probable maximum flood or 50 percent of the probable maximum flood without overtopping but will pass 35 percent of the probable maximum flood, which is greater than the estimated 100-year flood. Considering the small volume of water impounded by the dam and the downstream hazard, 50 percent of the probable maximum flood is the appropriate spillway design flood. The probable maximum flood is defined as the flood discharge which may be expected from the

most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Based on the size of dam and downstream hazard potential, the spillway should be capable of passing 50 percent of the probable maximum flood without overtopping the dam.

Deficiencies visually observed by the inspection team were animal burrows in the embankment and excessive vegetation in the spillway channel.

There are no other observed deficiencies or conditions existing at the time of the inspection which indicate an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage and stability analyses of the existing dam, are required by the guidelines. A detailed report discussing each of these deficiencies is attached.

Paul R. Zaman, PE
Illinois 62-29261

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Kansas 7539

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Black & Veatch

OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
J. M. KIRCHER DAM

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection be made of the J. M. Kircher Dam.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of a tributary to Camp Branch in east central Cass County, Missouri (Plate 1). The embankment consists of earth with a clay core as reported by the owner. The dam is 1,000 feet long with a typical crest width of 17 feet. Topography of the contributing watershed is characterized by rolling hills. The watershed is primarily comprised of row crops. Topography in the vicinity of the dam is shown on Plate 2.

(2) The primary spillway is located approximately 30 feet upstream from the axis of the dam at the approximate center. The drop inlet type spillway consists of a 34-inch steel pipe vertical shaft connected to a 22-inch steel pipe conduit through the embankment which discharges into a lake just downstream of the dam.

(3) The channel spillway is located in the left abutment along the centerline axis of the dam. The spillway is a notch cut in the left abutment of the dam. The spillway runs along the downstream abutment contact and has a very good grass lining (See Photo 10).

(4) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in east central Cass County, Missouri, as indicated on Plate 1. The lake formed by the dam is shown on the United States Geological Survey 7.5 minute series quadrangle map for East Lynne, Missouri in Section 5 of T44N, R30W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the small size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The J. M. Kircher Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For the J. M. Kircher Dam the estimated flood damage zone extends downstream for approximately two miles. Within the damage zone are P. D. Kircher Dam, six homes, two buildings, two railroads, and one unimproved road.

e. Ownership. The dam is owned by Jimmy M. Kircher, Route 1 Box 596, Harrisonville, Missouri 64701, telephone (816) 869-3287.

f. Purpose of Dam. The dam forms a 33-acre water supply lake for irrigation.

g. Design and Construction History. Data relating to the design and construction were not available. The owner did say that the dam was designed and built by himself and Ray Bolinger, Route 1, Box 650, Harrisonville, Missouri.

h. Normal Operating Procedure. The reservoir impounded by the J. M. Kircher Dam is the main water supply used in irrigating the J. M. Kircher farm. Water is drawn from the lake starting approximately in June and ending in September. The lake is sometimes dry by September due to the irrigating needs.

1.3 PERTINENT DATA

a. Drainage Area - 198 acres

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through the uncontrolled spillways.

(2) Estimated experienced maximum flood at damsite - unknown. The owner did say that the most water he has seen coming from the drop inlet was approximately 6 inches.

(3) Estimated ungated combined spillway capacity at maximum pool elevation - 310 cfs (top of Dam El.884.2).

(4) Water is pumped from the lake through a suction line located at the southwest end of the lake. Maximum pumping capacity is 1,000 gallons per minute (approximately 4.4 acre feet/day).

c. Elevation (Feet Above M.S.L.).

(1) Top of dam - 884.2 ± (see Plate 3)

(2) Primary spillway crest - 882.2

(3) Channel spillway crest - 882.2

(4) Streambed at centerline of dam - 858.0 ±

(5) Maximum tailwater - 871.9

d. Reservoir.

(1) Length of maximum pool - 2,500 feet ±

(2) Length of normal pool - 2,300 feet ±

e. Storage (Acre-feet).

(1) Top of dam - 358 (estimated)

(2) Primary spillway crest - 271 (estimated)

(3) Design surcharge - Not available.

f. Reservoir Surface (Acres).

(1) Top of dam - 41

(2) Primary spillway crest - 33

g. Dam.

(1) Type - Earth embankment

(2) Length - 1,000 feet ±

(3) Height - 26 feet ±

(4) Top width - 17 feet

(5) Side slopes - upstream face 1.0 V on 1.7 H, downstream face 1.0 V on 2.8 H (see Plate 4)

(6) Zoning - Clay core.

(7) Impervious core - Clay.

(8) Cutoff - Unknown.

(9) Grout curtain - Unknown.

h. Diversion and Regulating Tunnel - None.

i. Primary Spillway.

(1) Type - Drop inlet and vertical shaft.

(2) Size of orifice - 34 inch.

(3) Crest elevation - 882.2 feet m.s.l.

(4) Inlet of 22-inch steel pipe - 876.5 feet m.s.l.

(5) Outlet of 22-inch steel pipe - unknown.

(6) Upstream channel - Not applicable.

(7) Downstream channel - P. D. Kircher Lake.

j. Channel Spillway.

(1) Type - Grass open channel.

(2) Width of spillway - 22 feet (see Plate 5).

(3) Crest elevation - 882.2 feet m.s.l.

(4) Gates - None.

(5) Upstream channel - Grass and bare soil.

(6) Downstream channel - Grass channel along downstream abutment contact.

k. Regulating Outlets - None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data were unavailable.

2.2 CONSTRUCTION

Construction records were unavailable, however, according to the owner the dam was built in 1969.

2.3 OPERATION

The maximum recorded loading on the dam is unknown. Information regarding operation and maintenance was obtained verbally from the owner.

2.4 GEOLOGY

The J.M. Kircher Dam is located across a very broad shallow valley which contains a small intermittent tributary of Camp Branch of Big Creek. The soils of the valley are classified as the Grundy, Dennis, and Roseland soil series. The Grundy series was developed by weathering of wind-deposited silt (loess) originating from glaciated rocks and soils. It is anticipated that either glacial till and/or residual soil underlie the Grundy series. Some alluvial soil may also be present. The Dennis and Roseland series are residual silty clay soils developed from weathering of shale and sandstone bedrock. The bedrock consists of sandstone and shale of the Marmaton Group of the Pennsylvanian Period.

2.5 EVALUATION

a. Availability. No engineering data could be obtained.

b. Adequacy. No engineering data were available upon which to make a detailed assessment of the design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The validity of the design, construction, and operation could not be determined due to the lack of engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of J. M. Kircher Dam was made on 7 June 1979. The inspection team included professional engineers with experience in dam design and construction, hydrology - hydraulic engineering, and geotechnical engineering. The owner met the inspection team at the dam but did not accompany the team on the actual inspection. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection. In general, the dam appeared to be in good condition.

b. Dam. The inspection team observed the following items at the dam. In general, the embankment appeared to be in good condition. Slope protection on the front face of the dam consisted of 2 to 6 inch crushed limestone. The back slope of the dam was protected by a good grass cover. A few small animal burrows were observed in the embankment. There was no evidence of sliding, seepage, cracking, settlement, or sinkholes. The lake level at the time of the inspection was 1.4 feet below the spillway crest elevation.

c. Appurtenant Structures. The inspection team observed the following items pertaining to appurtenant structures. The primary spillway consists of a 34-inch steel pipe vertical shaft connected to a 22-inch steel pipe conduit through the dam. The lake level was approximately 1.4 feet below inlet. Only a few feet at the inlet end were observable. The pipe appeared to be in good condition with some rust and corrosion. The outlet end was submerged by the level of water in the P. D. Kircher Lake at the time of inspection. The channel spillway consists of a notch cut in the left abutment of the dam. A small tree was observed growing in the spillway channel. The channel was partially grass covered CL soil. Downstream from the channel spillway is P. D. Kircher Lake.

d. Geology. A visual inspection of the soils and geology of the dam confirmed the presence of silty clay soils. The embankment material would be classified as CL material. The materials in the foundation and abutments of the dam are silty clay with no visible rock outcrops. They are anticipated to be alluvial, loessal and/or residual silty-clay soils overlying sandstone and shale bedrock at shallow depths.

e. Reservoir Area. No slides or excessive erosion due to wave action were observed along the shore of the reservoir. Topography of the contributing watershed is characterized by rolling hills. The vegetation in the watershed is primarily comprised of row crops.

f. Downstream Channel. The natural channel downstream from the primary spillway is the P. D. Kircher Lake.

3.2 EVALUATION

The various minor deficiencies observed at the time of the inspection are not believed to represent any immediate safety hazard. They do, however, warrant repair and future monitoring and control. The growth of trees and brush in the channel spillway needs to be controlled to maintain maximum capacity of the existing spillway. There were a few small animal burrows observed in the embankment which should be eliminated to prevent the increase in the animal population.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool is normally controlled by rainfall, runoff, evaporation, water usage and capacity of the uncontrolled spillways. During dry periods of heavy usage, water in the reservoir is drawn down below the primary spillway level for irrigation usage.

4.2 MAINTENANCE OF DAM

There is no regularly scheduled program for maintenance. Grass on the embankment is cut periodically as needed.

4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance is performed as needed.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN AFFECT

There is no existing system or preplanned scheme for warning occupants of the hazard zone below this dam.

4.5 EVALUATION

One small tree (6 inch diameter) and various brush in the channel spillway have been allowed to grow. A few small animal burrows exist on the embankment. If these deficiencies are unchecked, they could lead to deterioration of the dam embankment.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics were unavailable.

b. Experience Data. The drainage area and lake surface area are developed from USGS East Lynne and Harrisonville Quadrangle Map. The spillway and dam layouts are from surveys made during the inspection and an aerial map obtained from Cass County ASCS Office, 302A South Main, Harrisonville, Missouri 64701.

c. Visual Observations.

(1) The 34-inch steel pipe of the primary spillway appears to be in good condition. No observation at the outlet of the discharge pipe was made due to the downstream lake level.

(2) The channel spillway is in good condition with no evidence of erosion at the time of the inspection. There is a small tree in the spillway channel which will cause minor resistance to flows.

(3) Spillway releases will not endanger the integrity of the dam.

(4) There are no facilities available which could serve to draw down the pool except the 1,000 gallon per minute water supply pumps.

(5) The primary spillway is located near the center of the dam approximately 30 feet from the centerline of the dam. The channel spillway is located in the left abutment.

d. Overtopping Potential. The spillway will not pass the probable maximum flood without overtopping. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass 35 percent of the probable maximum flood (320 cfs) without overtopping. This flood is greater than the 100-year flood estimated to be 150 cfs developed by a 24-hour, 100-year rainfall. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the small volume of water impounded by the dam and the downstream hazard, the appropriate spillway design flood should be 50 percent of the probable maximum flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 1,520 cfs of the total discharge from the reservoir of 2,620 cfs.

The estimated duration of overtopping is 5.1 hours at a maximum depth of 1.1 feet over the dam. The portion of the estimated peak discharge of 50 percent of the probable maximum flood overtopping the dam would be 250 cfs of the total discharge of the reservoir of 840 cfs. The estimated duration of overtopping is 2.6 hours at a maximum depth of 0.5 foot over the dam. Prolonged overtopping of the dam may cause erosion which could lead to failure. There was no evidence that the dam has been overtapped in previous years. Failure of upstream water impoundments shown on the 1954 USGS map would not have a significant impact on the hydrologic or hydraulic analysis.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately two miles downstream of the dam. The failure of this dam may cause the P. D. Kircher dam downstream to fail which would then cause the damage mentioned below. There are six homes, two buildings, two railroads, and one unimproved road downstream of the dam which could be severely damaged and lives could be lost should failure of the dam occur.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found. Detailed seepage and stability analysis should be performed as required by the guidelines. It is anticipated that the stability of this dam will meet the suggested factors of safety included in the guidelines.

c. Operating Records. No operational records exist.

d. Post Construction Changes. The owner reported that the primary spillway shaft was extended in 1973. The extension added a 12-inch section of pipe to the top of the drop inlet spillway. As a result, the present normal water level is one foot higher than the original normal water level.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone.

Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several items noted during the visual inspection by the inspection team which should be monitored or controlled are an uncontrolled stand of brush and trees in the channel spillway and animal burrows in the embankment. A seepage and stability analysis is needed to verify the safety of the embankment.

b. Adequacy of Information. Due to the lack of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. However, seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. It is the opinion of the inspection team that a program should be developed to implement remedial measures recommended in paragraph 7.2b. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam or identify any serious dangers that would require a Phase II investigation.

e. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

7.2 REMEDIAL MEASURES

a. Alternatives. The present spillway has the capacity to pass 35 percent of the probable maximum flood without overtopping the dam. In order to pass 50 percent of the probable maximum flood as required by the Recommended Guidelines, the spillway size and/or height of dam would need to be increased or the lake level would need to be lowered to increase storage capacity.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures should be implemented to correct the deficiencies observed at the time of inspection. If left unattended or unrepaired, each could possibly lead to further deterioration of the dam.

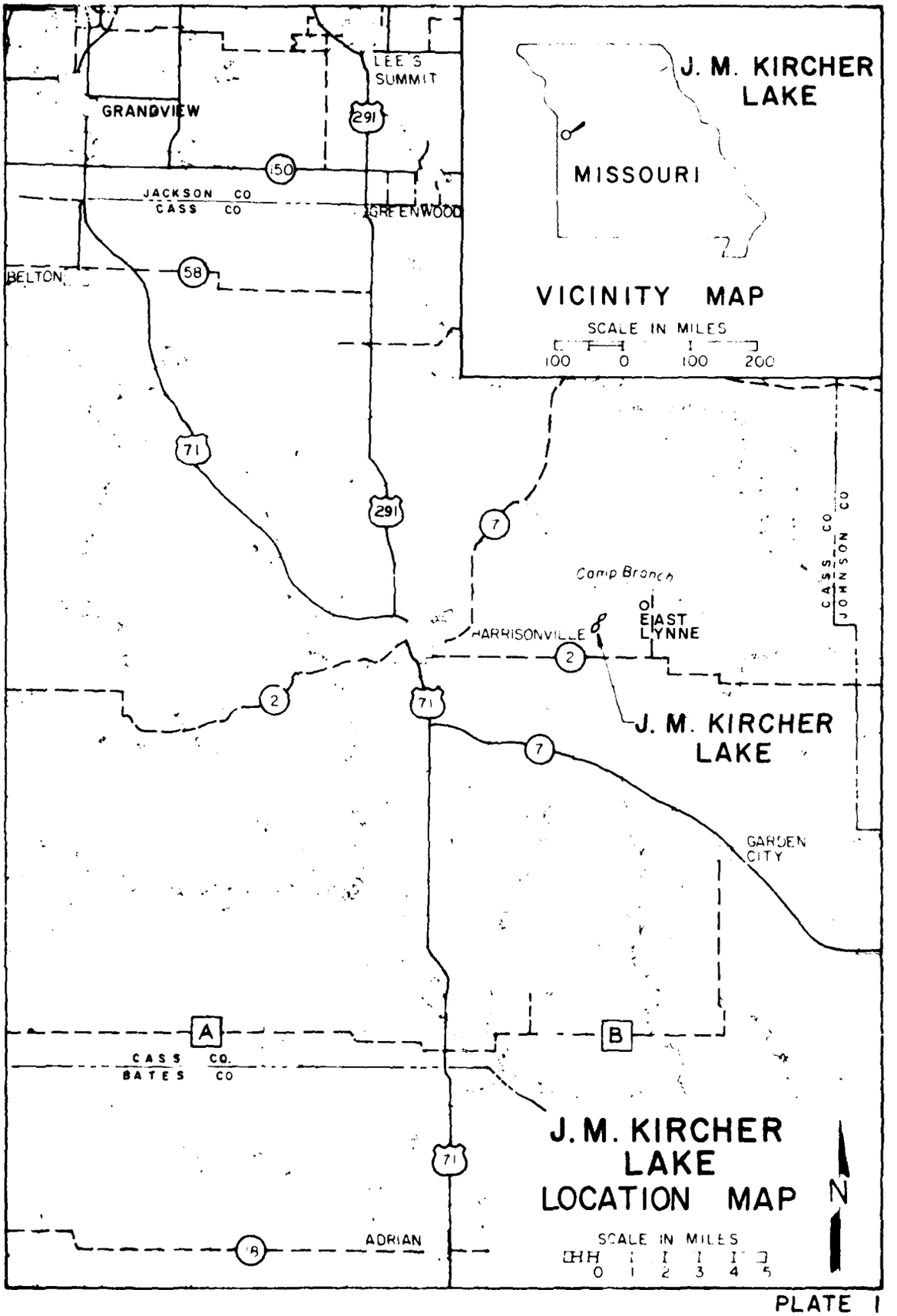
(1) Tree and brush growth should be controlled in the channel spillway area.

(2) The existing small animal burrows should be excavated, filled, and compacted under the direction of an engineer experienced in earthen dams, and a program of pest control should be established to reduce the animal population.

(3) Check the downstream face of the dam periodically for seepage and stability problems. If seepage flows are observed or sloughing on the downstream embankment slope is noted, the dam should immediately be inspected and the condition evaluated by an engineer experienced in design and construction of earthen dams.

(4) Seepage and stability analysis should be performed by a professional engineer experienced in the design and construction of dams.

(5) A detailed inspection of the dam should be made periodically by an engineer experienced in design and construction of dams. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increases.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GREENWOOD
BELTON
58
71
291
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Camp Branch
EAST LYNNE
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2
CASS CO
JOHNSON CO
J. M. KIRCHER LAKE
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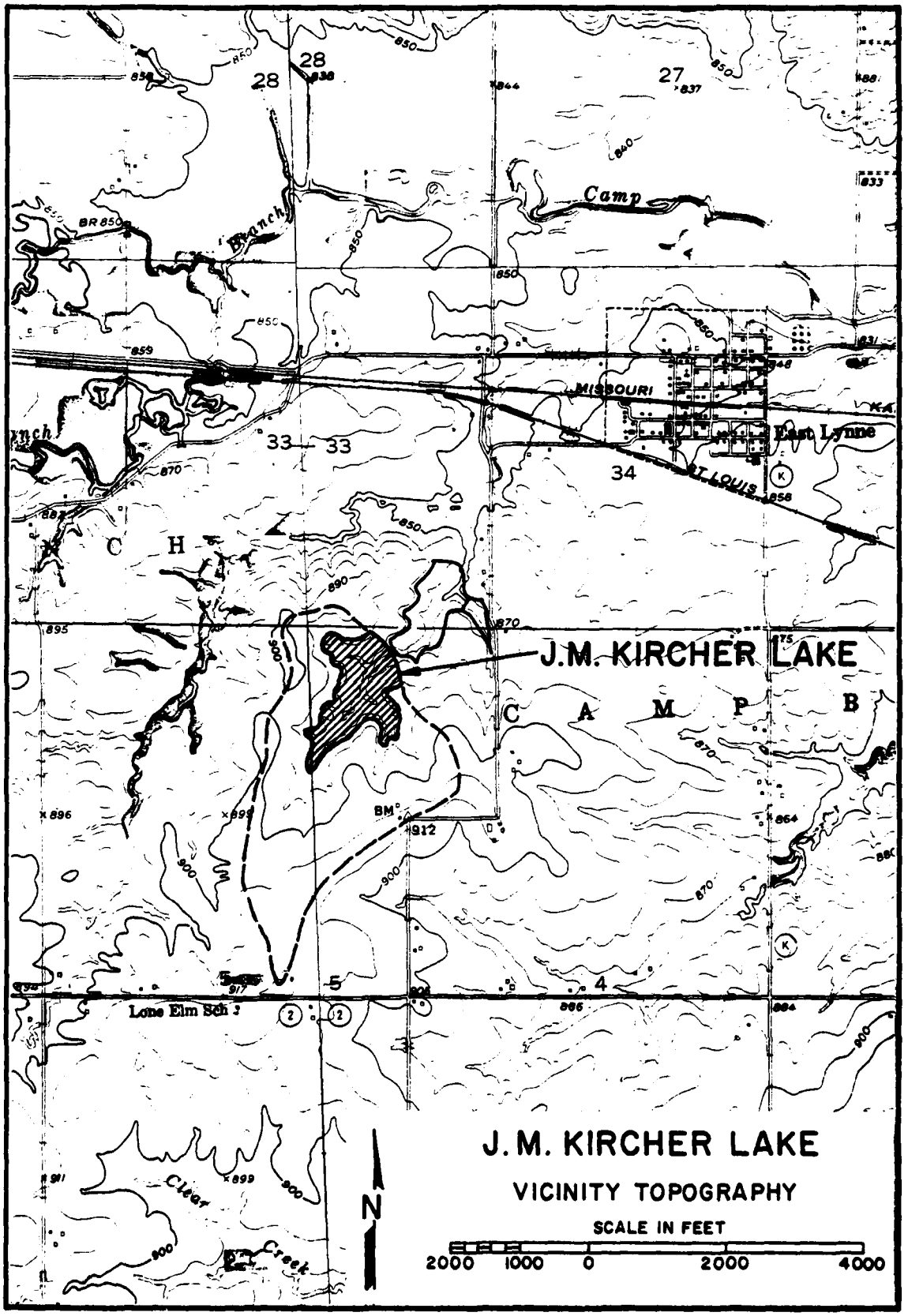
PLATE 1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CAMP
J.M. KIRCHER LAKE
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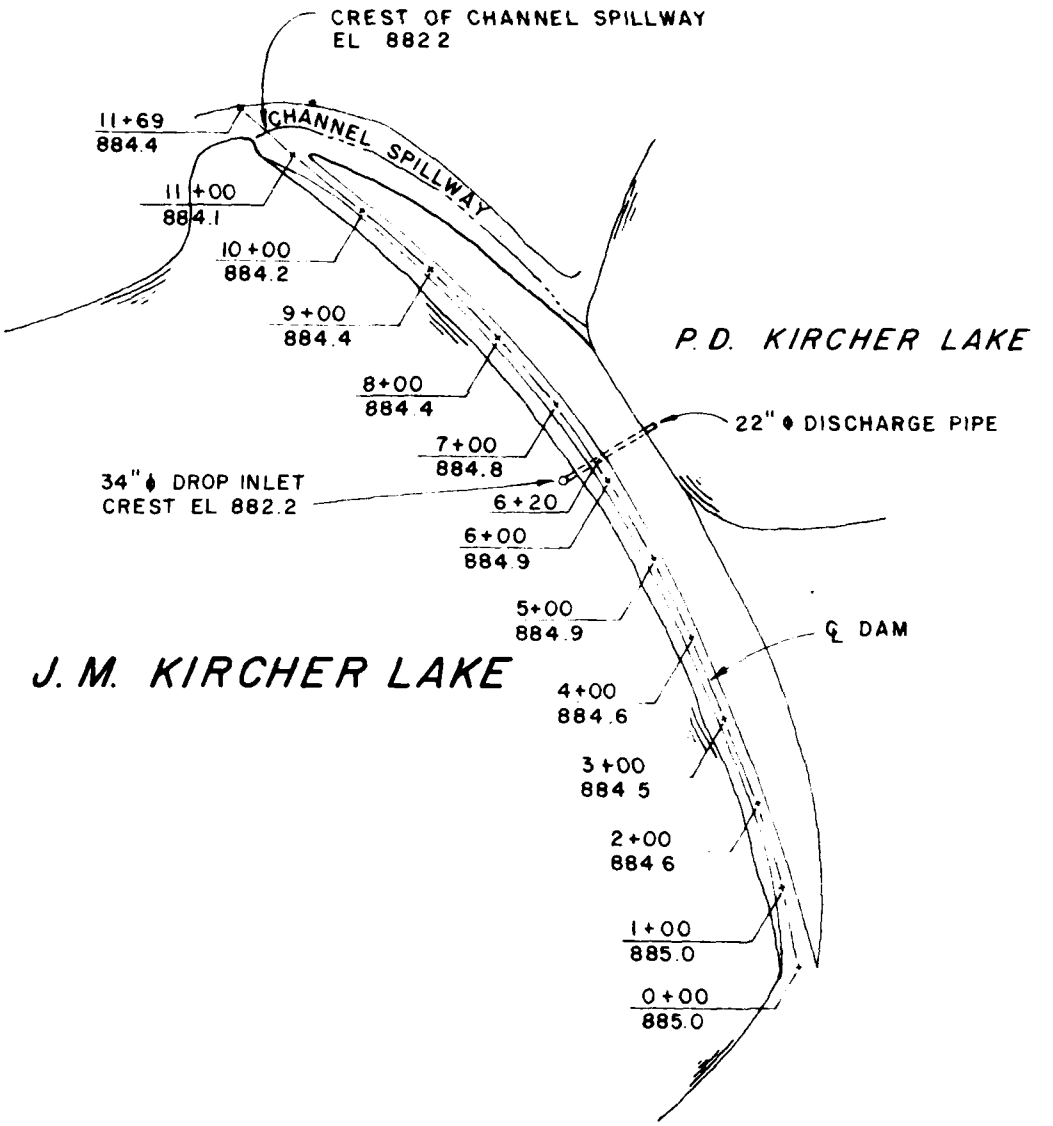
PLATE 2



J.M. KIRCHER LAKE
PLAN

PLATE 3

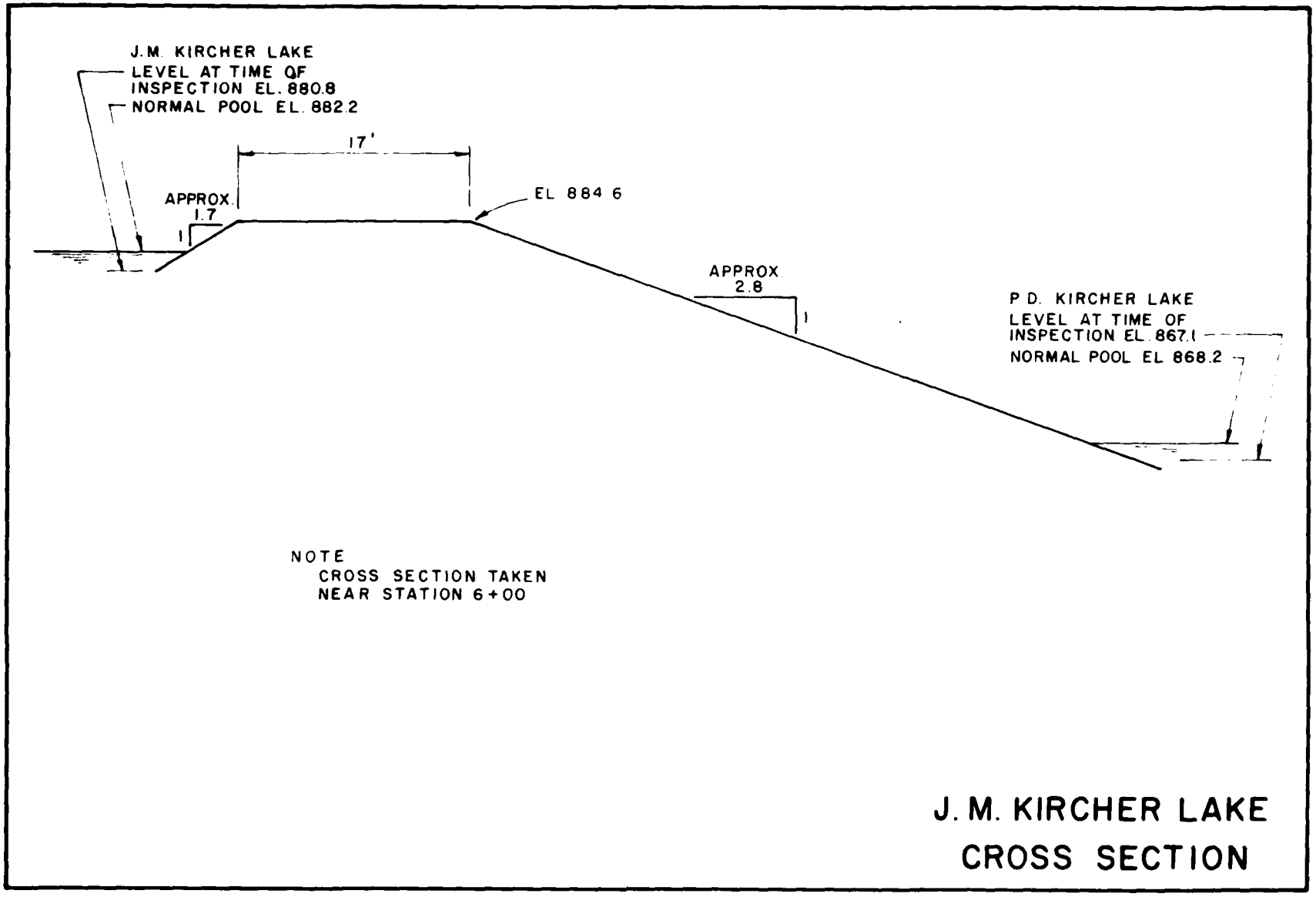
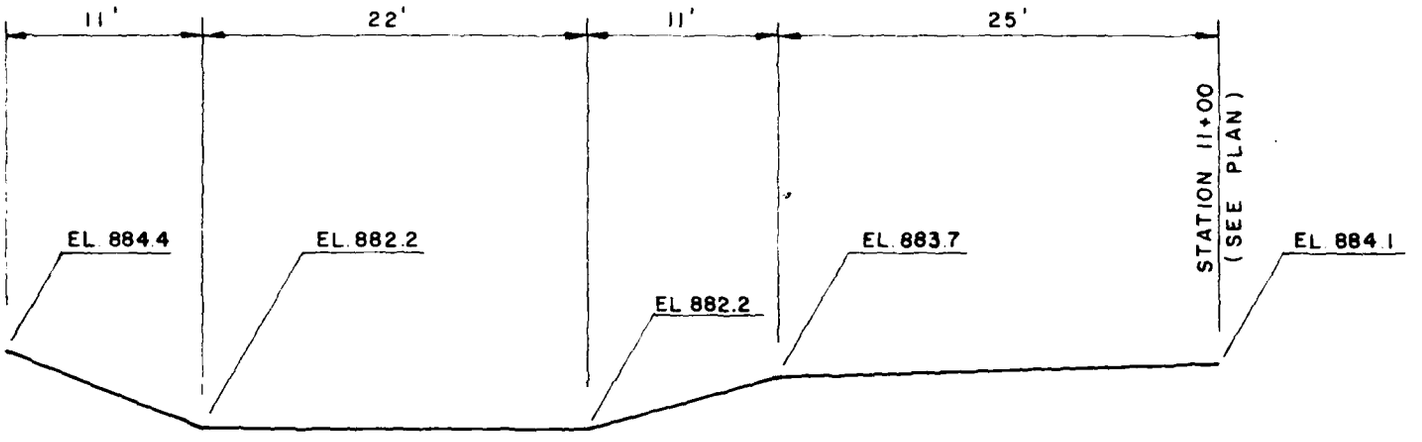


PLATE 4

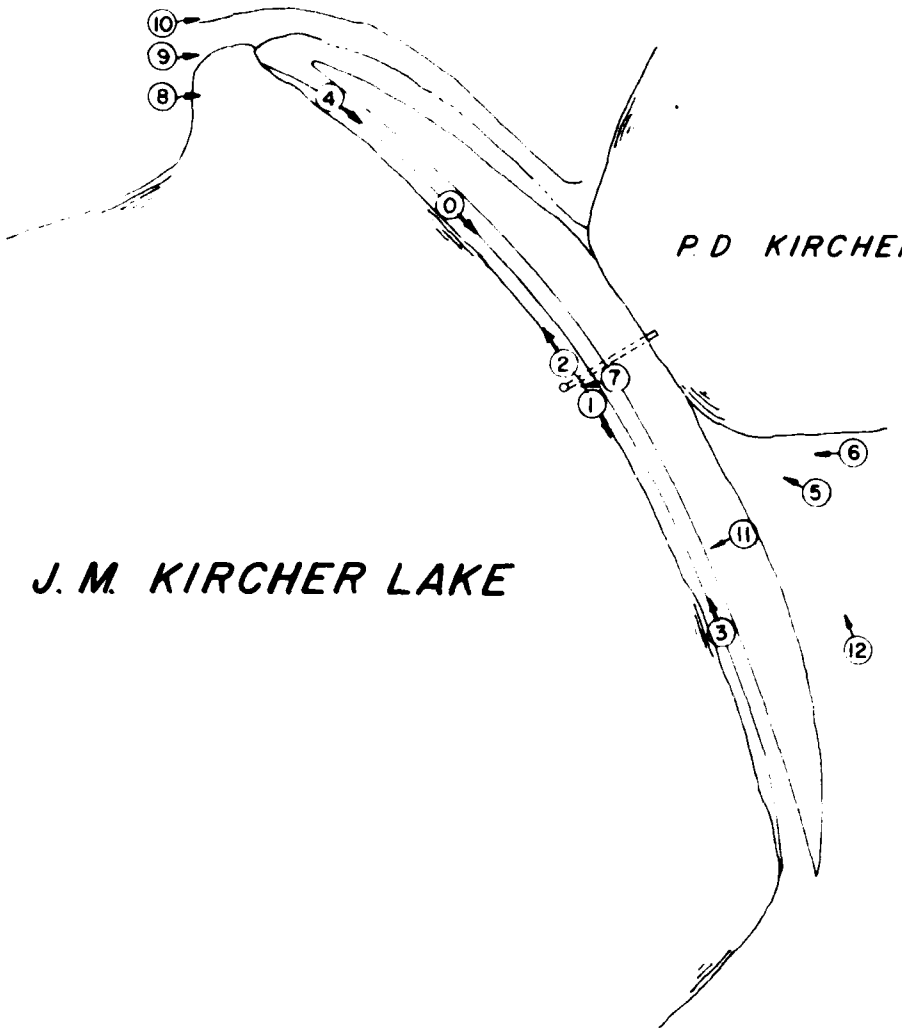
J. M. KIRCHER LAKE
CROSS SECTION



(LOOKING DOWNSTREAM)

PLATE 5

J.M. KIRCHER LAKE
CHANNEL SPILLWAY SECTION



LEGEND

1 PHOTO LOCATION AND DIRECTION

N

J.M. KIRCHER LAKE PHOTO INDEX

PLATE 6

PHOTO 1: UPSTREAM FACE OF DAM LOOKING SOUTHEAST

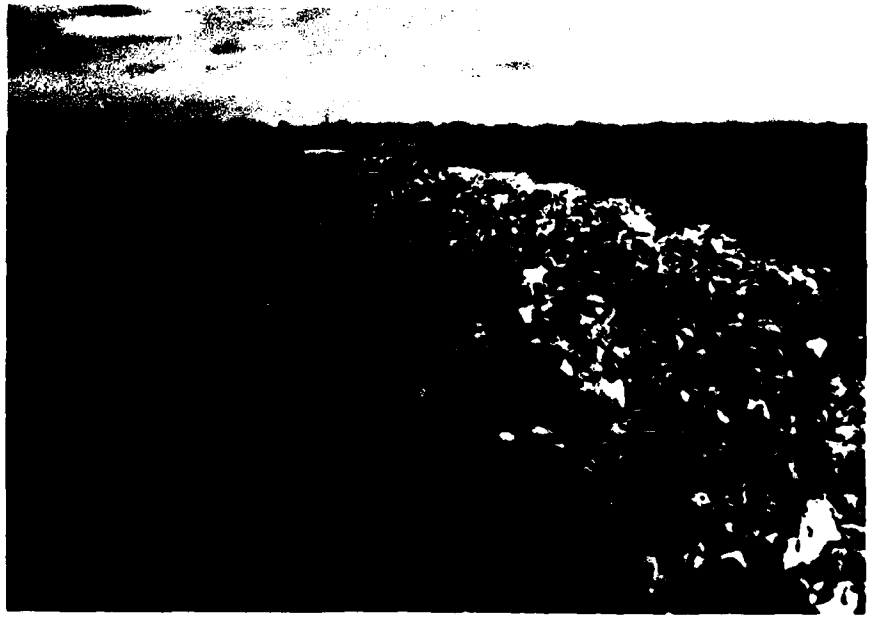


PHOTO 2: UPSTREAM FACE OF DAM LOOKING NORTHWEST

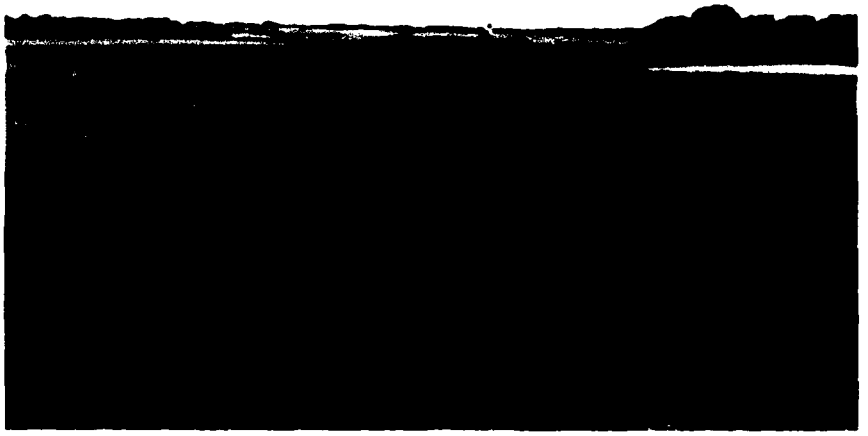


PHOTO 3: CREST OF DAM LOOKING NORTH

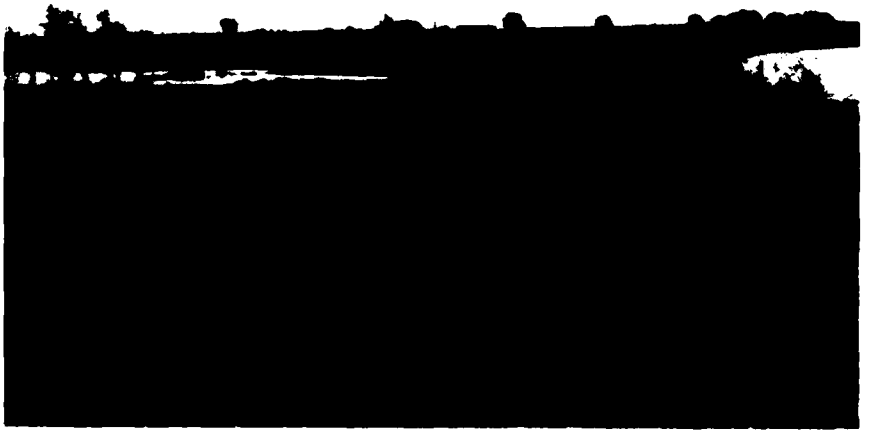


PHOTO 4: CREST OF DAM LOOKING SOUTHEAST

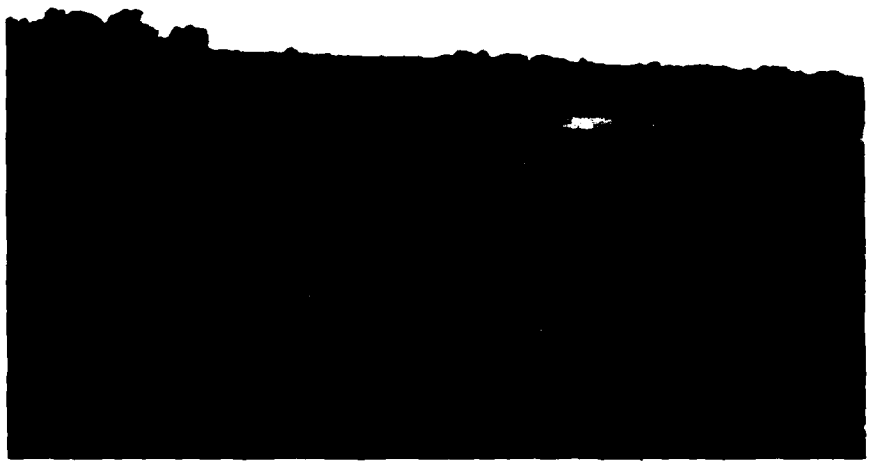


PHOTO 5: DOWNSTREAM SLOPE OF DAM LOOKING NORTHWEST

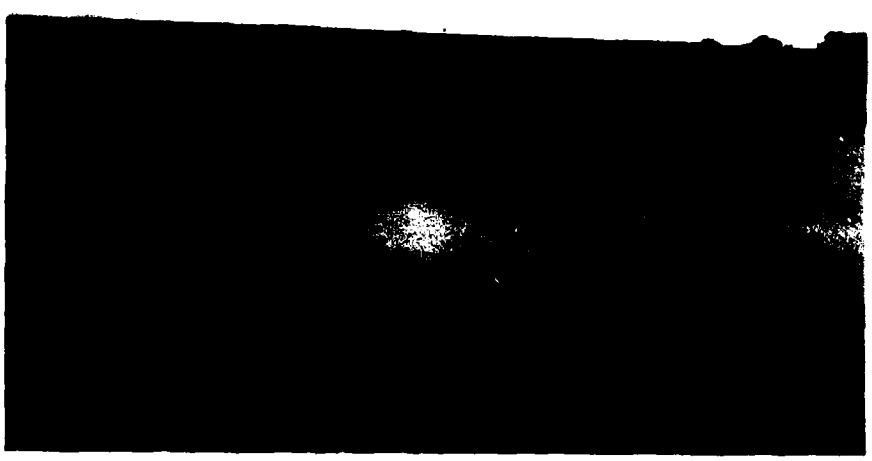


PHOTO 6: DOWNSTREAM SLOPE OF DAM LOOKING UPSTREAM FROM DOWNSTREAM LAKE

PHOTO 7: 34-INCH DROP INLET SPILLWAY

PHOTO 8: LOOKING AT APPROACH AREA OF DISCHARGE CHANNEL SPILLWAY

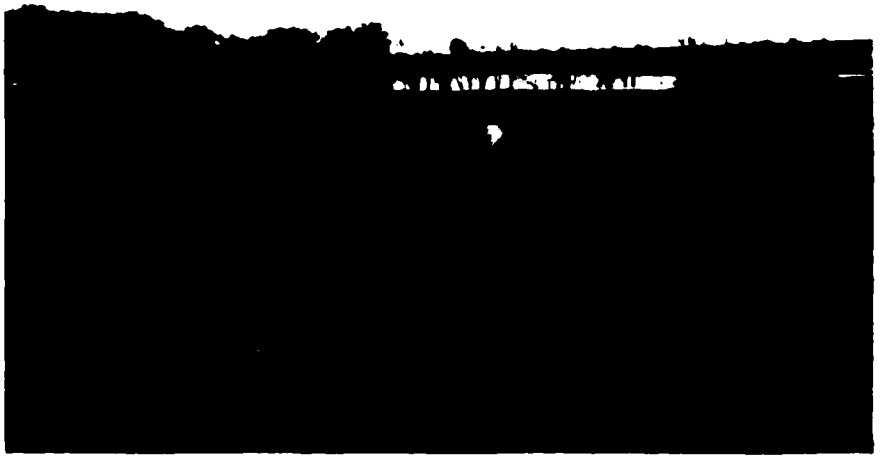


PHOTO 9: LOOKING AT CONTROL SECTION OF DISCHARGE CHANNEL SPILLWAY

PHOTO 10: LOOKING DOWNSTREAM AT DISCHARGE SPILLWAY

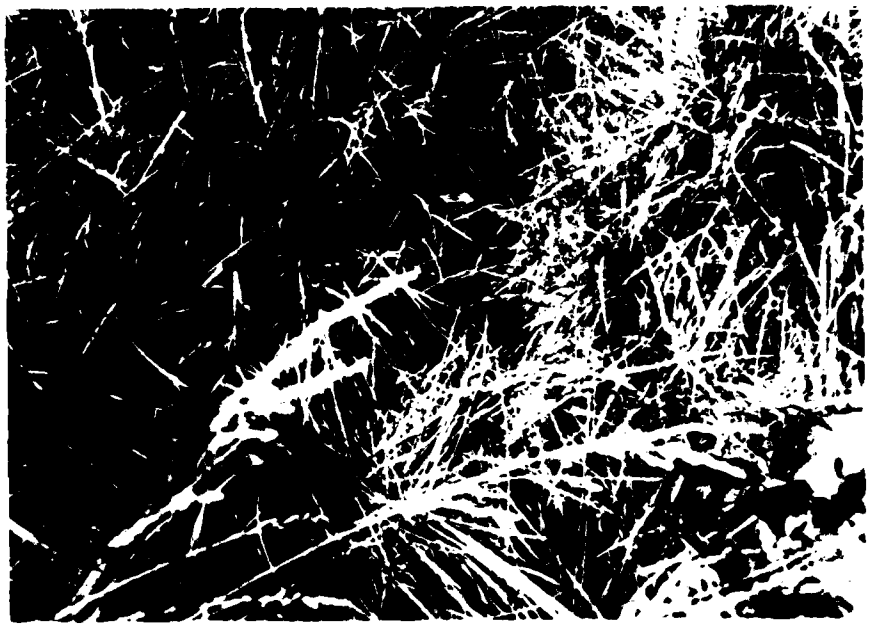


PHOTO 11: LOOKING AT ANIMAL BURROW
(Note 35-mm film box approx. 1 1/2" by 2 1/2")

PHOTO 12: LOOKING NORTH AT UPSTREAM AND DOWNSTREAM LAKES

APPENDIX A

HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Soil Conservation Service (SCS) dimensionless unit hydrograph (1) and HEC-1 (2) were used to develop the inflow hydrographs, and hydrologic inputs are as follows:

a. Twenty-four hour, probable maximum precipitation determined from U.S. Weather Bureau Hydrometeorological Report No. 33.

200 square mile, 24 hour rainfall inches	- 24.7
10 square mile, 6 hour percent of 24 hour 200 square mile rainfall	- 101%
10 square mile, 12 hour percent of 24 hour 200 square mile rainfall	- 120%
10 square mile, 24 hour percent of 24 hour 200 square mile rainfall	- 130%

b. Drainage area = 198 acres.

c. Time of concentration: $T_c = (11.9 \times L^3/H)^{0.385}$ = 0.41 hours = 25 minutes (L = 0.63 miles = length of longest watercourse in miles, H = 38 feet = elevation difference in feet) (3)

d. The soil association in this watershed is mainly Grundy (4).

e. Losses were determined in accordance with SCS methods for determining runoff using a curve number of 94 and antecedent moisture condition III. The hydrologic soil group in the basin was C (1).

f. The 100-year frequency inflow hydrograph was developed using a curve number of 85 and antecedent moisture condition II. Data for the 100-year, 24-hour rainfall, totaling 7.7 inches, were provided by the Corps of Engineers, St. Louis District.

2. Spillway release rates are based on a combination of both the sharp-crested weir equation and the orifice equation and the broad-crested weir equations for level and nonlevel weirs.

Combined sharp-crested weir and orifice equation:

$Q = C_o (2\pi R_s) H_o^{1.5}$ (C_o = 3.8 to 1.0 - varying with approach depths and types of flow, R_s = 1.4 feet = radius of the pipe in feet for the primary spillway, H_o is the head on the weir in feet) (3).

Broad-crested weir equation:

$Q = CLH^{1.5}$ (C = 2.6 to 3.0 , L = 22 feet for the channel spillway, H is the head on the weir in feet).

Broad-crested nonlevel weir equation:

$$Q = \frac{2Cb}{5(h_b - h_a)} (h_b^{2.5} - h_a^{2.5})$$

(C = 2.5 to 3.0, b = length of flow normal to weir = 2.0 to 25 feet, h_a is the head on the high end of the weir in feet and h_b is the head on the low end of the weir (5).

Discharge rates over the top of the dam are also based on the broad-crested weir equations for weirs level and nonlevel:

Broad-crested level weir equation:

$Q = CLH^{1.5}$ (C = 2.5 to 2.9, and L = 100 to 300 feet).

Broad-crested nonlevel weir equation:

$Q = \frac{2Cb}{5(h_b - h_a)} (h_b^{2.5} - h_a^{2.5})$ (C = 2.5 to 3.0, and b = 25 to 700 feet).

3. The elevation-storage relationship was constructed by planimetering the area enclosed within each contour on the USGS maps. The storage between two elevations was computed by multiplying the average of the areas at the two elevations by the elevation difference. The summation of these increments below a given elevation is the storage below that level.

4. Floods are routed through the spillway using HEC-1, modified Puls to determine the capability of the spillway.

(1) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972.

(2) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Davis, California.

(3) U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, 1974, Washington, D.C.

(4) Mid-America Regional Council, Regional Soils Guide, March 1976, Kansas City, Missouri.

(5) U.S. Department of the Interior, Geological Survey, Techniques of Water-Resources Investigations, Book 3, Chapter A5, Measurement of Peak Discharge at Dams by Indirect Method, by Harry Hulsing, 1967.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1                 A1MISSOURI DAM INSPECTION PROGRAM
    2                 A2ST LOUIS DISTRICT  US ARMY CORPS OF ENGINEERS
    3                 A3 J.M.KIRCHER DAM I.D.#31075 & P.D.KIRCHER DAM I.D.#31074
    4                 S    288        0        5        0        0        0        0        0        0        0
    5                 B1     5
    6                 J      1        9        1
    7                 J1   .15       .2      .25       .3      .35      .40      .45       .5       1.
    8                 K      0        1                                  3        1
    9                 K1   J.M.KIRCHER (24HR. PROBABLE MAXIMUM RUNOFF)
   10                 M      1        2     .210                         1
   11                 P             24.7      101      120      130
   12                 T                                                          -1      -94
   13                 M2             .25
   14                 X                       1
   15                 K      1        2                                          1
   16                 K1   ROUTING THROUGH J.M.KIRCHER RESERVOIR
   17                 Y                                1        1
   18                 Y1     1                                          -882.2       -1
   19                 Y4882.2 882.5   883.0   883.5   884.0   884.2   884.5   885.0   885.5   886.0
   20                 Y50.0    15.5     71.     143.     253.     393.     497.    1423.    3470.    6340.
   21                 $S0.     0.4     25.4     175.9    609.4
   22                 $E858.   860.    870.     880.     890.
   23                 $$882.2
   24                 $D884.2
   25                 K      0        3                                  3        1
   26                 K1   OTHER AREA ABOVE P.D.KIRCHER DAM (24HR. PROBABLE MAXIMUM RUNOFF)
   27                 M      1        2    0.20                         1
   28                 P             24.7      101      120      130
   29                 T                                                          -1      -94
   30                 M2             .14
   31                 X                       1
   32                 K      2        4                                          1
   33                 K1   COMBINE HYDROGRAPHS - TOTAL INFLOW HYDROGRAPH TO P.D.KIRCHER  (24HR. PMF)
   34                 K      1        5                                          1
   35                 K1   ROUTING THROUGH P.D.KIRCHER RESERVOIR
   36                 Y                                1        1
   37                 Y1     1                                          -868.2       -1
   38                 Y4868.2 868.5   869.0   869.5   870.0   870.5   871.0   871.1   871.5   872.0
   39                 Y4573.0
   40                 Y5   0.03.      41.     143.     370.     773.    1326.    1459.    2222.    3953.
   41                 Y510297.
   42                 $S0.0    0.3     52.8     248.3    719.3
   43                 $E849.   850.    860.     870.     880.
   44                 $$868.2
   45                 $D871.1
   46                 K     99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .15	RATIO 2 .20	RATIO 3 .25	RATIO 4 .30	RATIO 5 .35	RATIO 6 .40	RATIO 7 .45	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	1	.31	1	454.	605.	756.	908.	1059.	1210.	1362.	1513.	3026.
	(	.80)	(	12.85)(	17.14)(	21.42)(	25.70)(	29.99)(	34.27)(	38.56)(	42.84)(	85.68)
ROUTED TO	2	.31	1	101.	144.	197.	250.	325.	443.	627.	837.	2620.
	(	.80)	(	2.86)(	4.08)(	5.59)(	7.09)(	9.20)(	12.54)(	17.74)(	23.71)(	74.19)
HYDROGRAPH AT	3	.20	1	380.	506.	633.	759.	886.	1012.	1139.	1265.	2530.
	(	.52)	(	10.75)(	14.33)(	17.91)(	21.49)(	25.07)(	28.66)(	32.24)(	35.82)(	71.64)
2 COMBINED	4	.51	1	437.	589.	745.	899.	1059.	1221.	1382.	1551.	4078.
	(	1.32)	(	12.37)(	16.67)(	21.09)(	25.46)(	30.00)(	34.58)(	39.12)(	43.91)(	115.30)
ROUTED TO	5	.51	1	205.	317.	410.	489.	570.	668.	810.	1007.	3513.
	(	1.32)	(	5.80)(	8.97)(	11.60)(	13.86)(	16.15)(	18.91)(	22.93)(	28.51)(	99.49)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	882.20	882.20	884.20
STORAGE	271.	271.	358.
OUTFLOW	0.	0.	313.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.15	883.19	0.00	314.	101.	0.00	17.17	0.00
.20	883.47	0.00	326.	144.	0.00	16.83	0.00
.25	883.74	0.00	338.	197.	0.00	16.58	0.00
.30	883.99	0.00	349.	259.	0.00	16.50	0.00
.35	884.22	.02	359.	325.	.50	16.42	0.00
.40	884.41	.21	367.	447.	1.67	16.25	0.00
.45	884.57	.37	374.	627.	2.25	16.17	0.00
.50	884.68	.48	379.	837.	2.58	16.08	0.00
1.00	885.29	1.09	405.	2620.	5.08	15.92	0.00


FILME